

What is claimed is:

1 1. A method comprising:

2 determining a slack value for each of one or more ready instructions based on resource
3 constraints;

4 selecting one of the ready instructions, based on the slack value; and
5 scheduling the selected ready instruction.

1 2. The method of claim 1, further comprising:

2 performing the method set forth in claim 1 until all instructions in a scheduling region
3 have been scheduled.

1 3. The method of claim 1, wherein:

2 determining a slack value for each of the one or more ready instructions further
3 comprises determining the slack value for the instruction based on resource
4 constraints and dependence height.

1 4. The method of claim 1, wherein determining a slack value further comprises:

2 determining a dependence deadline based on a dependence height for the instruction;
3 determining a resource deadline based on resource constraints for the instruction;

4 selecting between the resource deadline and the dependence deadline to choose a
5 deadline value that indicates a least number of cycles; and

6 determining the slack value based on the selected deadline value.

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1 5. The method of claim 1, wherein:

2 selecting one of the ready instructions further comprises selecting a ready instruction
3 having a lowest slack value.

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1 6. The method of claim 1, further comprising:

2 generating an entry in a ready list for each of the one or more ready instructions; and
3 removing the entry for the selected ready instruction from the ready list.

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1 7. The method of claim 6, further comprising:

2 adding to an uncover list any instructions uncovered by the scheduling of the selected
3 ready instruction.

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1 8. The method of claim 6, further comprising:

2 advancing a virtual clock to a subsequent clock cycle; and
3 adding an entry to the ready for list for any instruction that becomes ready in the
4 subsequent clock cycle.

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1 9. The method of claim 1, further comprising:
2 determining a minimum number of cycles needed to schedule the instructions of a
3 scheduling region, taking resource constraints into account.

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1 10. The method of claim 9, wherein:
2 the minimum number of cycles is determined to be a dependence length of the scheduling
3 region if the scheduling region is dependence-bound; and
4 the minimum number of cycles is determined to be a resource length of the scheduling
5 region if the scheduling region is resource-bound.

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1 11. The method of claim 10, further comprising:
2 calculating the dependence length of the scheduling region based on the total height of a
3 dependence graph of the scheduling region; and
4 calculating the resource length of the scheduling region based on the maximum number
5 of cycles needed to schedule the instructions of the scheduling region for a machine resource.

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1 12. The method of claim 1, wherein:
2 the resource constraints include the maximum number of instructions of a particular
3 instruction type that can be scheduled during a given cycle for a selected target processor.

1 13. An article comprising:

2 a storage medium having a plurality of machine accessible instructions, which if executed

3 by a machine, cause the machine to perform the following operations:

4 determining a slack value for each of one or more ready instructions based on resource

5 constraints;

6 selecting one of the ready instructions, based on the slack value; and

7 scheduling the selected ready instruction.

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1 14. The article of claim 13, wherein:

2 the plurality of machine accessible instructions further include instructions, which if

3 executed by a machine, cause the machine to perform the method set forth in claim 1

4 until all instructions in a scheduling region have been scheduled.

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1 15. The article of claim 13, wherein the instructions, which if executed by a machine,

2 cause the machine to perform determining a slack value further comprise

3 instructions, which if executed by a machine, cause the machine to perform:

4 determining the slack value for the instruction based on resource constraints and

5 dependence height.

1 16. The article of claim 15, wherein the instructions, which if executed by a machine,
2 cause the machine to perform determining a slack value further comprise
3 instructions, which if executed by a machine, cause the machine to perform:
4 determining a dependence deadline based on a dependence height for the instruction;
5 determining a resource deadline based on resource constraints for the instruction;
6 selecting between the resource deadline and the dependence deadline to choose a
7 deadline value that indicates a least number of cycles; and
8 determining the slack value based on the selected deadline value.

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1 17. The article of claim 13, wherein:
2 instructions that cause the machine to perform selecting one of the ready instructions
3 further comprise instructions, which if executed by a machine, cause the machine to
4 perform selecting a ready instruction having a highest scheduling priority.

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1 18. The article of claim 13, wherein the plurality of instructions further comprise
2 instructions, which if executed by a machine, cause the machine to perform:
3 generating an entry in a ready list for each of the one or more ready instructions; and
4 removing the entry for the selected ready instruction from the ready list.

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1 · 19. The article of claim 18, wherein the plurality of instructions further comprise
2 instructions, which if executed by a machine, cause the machine to perform:
3 adding to an uncover list any instructions uncovered by the scheduling of the selected
4 ready instruction.

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1 20. The article of claim 18, wherein the plurality of instructions further comprise
2 instructions, which if executed by a machine, cause the machine to perform:
3 advancing a virtual clock to a subsequent clock cycle; and
4 adding an entry to the ready for list for any instruction that becomes ready in the
5 subsequent clock cycle.

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1 21. The article of claim 13, wherein the plurality of instructions further comprise
2 instructions, which if executed by a machine, cause the machine to perform:
3 determining a minimum number of cycles needed to schedule the instructions of a
4 scheduling region, taking resource constraints into account.

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1 22. The article of claim 21, wherein the plurality of instructions further comprise
2 instructions, which if executed by a machine, cause the machine to perform:
3 determining the minimum number of cycles to be a dependence length of the scheduling
4 region if the scheduling region is dependence-bound; and

5 determining the minimum number of cycles to be a resource length of the scheduling
6 region if the scheduling region is resource-bound.

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1 23. The article of claim 22, wherein the plurality of instructions further comprise
2 instructions, which if executed by a machine, cause the machine to perform:
3 calculating the dependence length of the scheduling region based on the total height of a
4 dependence graph of the scheduling region; and
5 calculating the resource length of the scheduling region based on the maximum number
6 of cycles needed to schedule the instructions of the scheduling region for a machine resource.

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1 24. The article of claim 13, wherein:
2 the resource constraints include the maximum number of instructions of a particular
3 instruction type that can be scheduled during a given cycle for a selected target
4 processor.

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1 25. A compiler comprising:
2 a front end; and
3 a code generator;
4 wherein the code generator includes one or more resource-aware schedulers to schedule
5 instructions, the one or more resource-aware schedulers to take resource constraints
6 into account to generate a slack value for each of the instructions.

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1 26. The compiler of claim 25, wherein:

2 said one or more resource-aware schedulers is further to determine a first scheduling
3 deadline for an instruction in a scheduling region, taking dependence considerations
4 into account; and

5 said one or more resource-aware schedulers is further to determine a second scheduling
6 deadline for the instruction, taking resource constraints into account; and

7 said one or more resource-aware schedulers is further to select between the first and
8 second scheduling deadlines to choose a scheduling priority for the instruction.

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1 27. The compiler of claim 25, wherein:

2 said resource-aware scheduler is further to select among ready instructions to select an
3 instruction for scheduling.

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1 28. The compiler of claim 26, wherein:

2 said resource-aware scheduler is further to select the instruction for scheduling based on
3 its scheduling priority.

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1 29. The compiler of claim 25, wherein:

2 said resource constraints include a maximum number of instructions that can be
3 scheduled per cycle.

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1 30. The compiler of claim 25, wherein:

2 said resource constraints include the maximum number of instructions of a particular
3 instruction type that can be scheduled per cycle.

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1 31. The compiler of claim 25, wherein:

2 the resource-aware scheduler is further to schedule the instructions such that instructions
3 of a particular instruction type are distributed evenly among two or more resources.

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1 32. A system comprising:

2 a processor; and

3 a memory system to store instructions;

4 wherein the instructions include a resource-aware scheduler to determine, based on
5 resource constraints, a slack-based scheduling priority for each of one or more instructions.

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1 33. The system of claim 32, wherein:

2 the memory system includes a DRAM.

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1 34. The system of claim 32, wherein:

2 said resource-aware scheduler is further to determine a first scheduling deadline for an

3 instruction in a scheduling region, taking dependence considerations into account;

4 and

5 said resource-aware scheduler is further to determine a second scheduling deadline for

6 the instruction, taking resource constraints into account; and

7 said resource-aware scheduler is further to select between the first and second scheduling

8 deadlines to determine the scheduling priority for the instruction.

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1 35. The system of claim 32, wherein:

2 said resource-aware scheduler is further to select among ready instructions to select an

3 instruction for scheduling.

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1 36. The system of claim 35, wherein:

2 said resource-aware scheduler is further to select the instruction for scheduling based on

3 its scheduling priority.

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1 37. The system of claim 32, wherein:

2 said resource constraints include a maximum number of instructions that can be

3 scheduled per cycle.

- 1 38. The system of claim 32, wherein:
2 said resource constraints include the maximum number of instructions of a particular
3 instruction type that can be scheduled per cycle.